Electronic Version

Stylesheet Version v1.1.1

Description

[ELECTRICAL SAFETY DEVICE]

BACKGROUND OF INVENTION

[0001] This application claims the benefit of and incorporates by reference U.S. Provisional Application No. 60/319994 filed March 7, 2003.

[0002] The present invention generally relates to devices for determining if electrical power is removed from an electrically powered apparatus, so that the electrically powered apparatus may be safely serviced by an operator. More specifically, the present invention relates to a device which is accessible from the outside of the electrically powered apparatus and is connected to the electrical power source of the electrically powered apparatus, whereby the device is configured to protect an operator of the electrically powered apparatus from the electrical power connected to the device.

[0003] High voltage machinery can pose a danger to an operator of the machinery during a malfunction, service or adjustment of the machinery. There are two common dangers in

which the operator can be injured due to the electrical power to the machine not being properly turned off. The first is failure of currently available electrical power indication safety devices on the machinery, which give a false indication of the electrical power being off or malfunction and fail to given any indication of whether the electrical power is on or off. The second is inexperience of the operator in determining if the electrical power is on or off in situations where the safety device fails and in situations where the machinery does not have an electrical power indication safety device. The solution to such dangers is to not allow the operator to work on the machinery until electrical power shutdown is verified by a qualified electrician. Waiting for a qualified electrician can incur additional operating costs, due to down time and the labor of the electrician. An improved solution would be a device which provides a simple process for the operator to verify the electrical power is off and eliminates many of the components of current devices which can malfunction.

[0004] It is an object of the present invention to provide a device accessible from an outside of an electrically powered apparatus which allows an operator of the electrically powered apparatus to determine if the electrical power is re-

moved.

[0005] It is another object of the present invention to provide a device accessible from an outside of an electrically powered apparatus which will not cause injury to the operator due to contact with the device even if the electrical power of the electrically powered apparatus is on.

SUMMARY OF INVENTION

[0006] An electrical safety device used with an electrical enclosure and a probe. The electrical safety device including a non-conductive body. The non-conductive body having a front, a mounting body and a rear. The non-conductive body mounted such that the front of the non-conductive body is exposed. The mounting body securing the non-conductive body to the enclosure. The rear of the non-conductive body protected by the enclosure. The electrical safety device including at least one conducting wire entering into the rear of the non-conductive body. The wire having an exposed section within the non-conductive body near the front of the non-conductive body. The exposed section of the wire being a depth from an outside face of the front of the non-conductive body, whereby the depth is enough to prevent passing of electrical current, yet close enough to allow the probe to be activated when

electrical current is present in the wire.

BRIEF DESCRIPTION OF DRAWINGS

[0007] Fig. 1 is a perspective view of an electrical safety device according to the present invention.

[0008] Fig. 2 is a perspective view of a non-conducting body according to the present invention.

[0009] Fig. 3 is a perspective view of a non-conducting body according to the present invention.

[0010] Fig. 4 is a side sectional view of a non-conducting body according to the present invention.

[0011] Fig. 5 is a perspective view of an enclosure according to the present invention.

[0012] Fig. 6 is a side sectional view of a non-conducting body according to the present invention.

[0013] Fig. 7 is a perspective view of a non-conducting body according to the present invention.

[0014] Fig. 8 is a front view of a non-conducting body according to the present invention.

[0015] Fig. 9 is a side sectional view of a non-conducting body according to the present invention.

[0016] Fig. 10 is a side cut-a-way view of a non-conducting body according to the present invention.

[0017] Fig. 11 is a side view of an electrical safety device accord-

ing to the present invention.

[0018] Fig. 12 is a front view of an electrical safety device according to the present invention.

[0019] Fig. 13 is a side cut-a-way and front view of a non-conducting body according to the present invention.

DETAILED DESCRIPTION

[0020] The present invention is an electrical safety device 10 as shown in Figs. 1-13. Figs. 1-5 show a first version of the electrical safety device 10 and Figs. 6-9 show a second version of the electrical safety device 10. The electrical safety device 10 positions voltage test points at an outside position of an enclosure 12 of an electrically powered apparatus, such as an electrical starter. The enclosure 12 of an electrical starter typically encloses the electrical power devices and wiring to operate large motors in industrial applications. The enclosure 12 serves the purpose of protecting operators from contacting the electrical power devices and wiring in order to prevent injury of the operators when the electrical power is on. The electrical safety device 10 provides a simplified and cost effective means for the operator to determine if the electrical power in the enclosure 12 has been turned off properly. The electrical safety device 10 is easy to add to existing

enclosures 12. Both versions of the electrical safety device 10 include electrical conductors which are energized when the power is turned on. The voltage in the energized electrical conductors can be sensed using a proximity voltage sensor 14 held near the energized electrical conductors, which are enclosed by the electrical safety device 10. The proximity voltage sensor 14 senses the electric field near an energized conductor and indicates the conductor is energized. The indication is usually done by the illumination of a light or lights on the proximity voltage sensor 14. The proximity voltage sensor 14 does not need to be in direct contact with the conductor to sense voltage. It works on the principle of capacitance coupling. The proximity voltage sensor 10 can sense the voltage through an insulated energized electrical conductor and does not need to have current flowing through the energized electrical conductor, but simply needs the energized electrical conductor to be energized with AC voltage. The device used to verify results with the present invention was the Fluke VoltAlert 1AC, though proximity voltage sensors 14 are manufactured by several different companies. All versions of the electrical safety device 10 not do not require electronics, which increases the reliability of the electrical

safety device 10.

[0021] The electrical safety device 10 shown in Figs. 1-5 is an example of the first version. The electrical safety device 10 includes a non-conductive body 16, support bracket 18 and wire bundle 20. The non-conductive body 16 is typically made of a type 6 nylon natural material, which is a good electrical insulator, as well as being strong. The non-conductive body 16 can be made of any good electrical insulator, such as PVC plastics. The non-conductive body 16 includes a front face 22 and rear face 24. The front face 22 of the non-conductive body 16 includes a slot shaped open cavity 26. The slot shaped open cavity 26 is wide enough to receive a tip 28 of the proximity voltage sensor 14 and has sides 30 and a bottom 32. The rear face 24 includes copper wire terminals 34 embedded into or attached to the non-conductive body 16. Six wire terminals 34 are shown for a typical enclosure 12 that houses the starter electronics for an three phase industrial motor. There are five wires 36 in the wire bundle 20 for a typical enclosure 10 that houses the starter electronics for a three phase industrial motor. Four of the five wires 36 are electrical conductors which can be energized. The fifth wire 36 is a ground wire. The five wires 36 are connected

between the wire terminals 34 and the electrical components of the enclosure 12. As an example, a first wire 36 is connected between a first wire terminal 34 and a one-hundred-and-twenty (120) volt component. A second wire 36 is connected between a second wire terminal 34 and a ground source. There is a jumper cable 38 connected between the second wire terminal 34 and the third wire terminal 34. A third wire 36 is connected between a fourth wire terminal 34 and one of the voltage points within the starter for the three phase configuration. A fourth wire 36 is connected between a fifth wire terminal 34 and one of the voltage points within the starter for the three phase configuration. A fifth wire 36 is connected between a sixth wire terminal 34 and one of the voltage points within the starter for the three phase configuration. The current carried by the wires 36 is zero (0)Amps because the wires 36 are "dead-ended" at the wire terminals 34. For this reason the electrical safety device 10 uses no fuses, which means less cost for manufacture and a more reliable device. Fig. 4 shows a layer 40 of non-conducting material between the wire terminals 34 and the slot shaped open cavity 26 which protects the operator from contact with the five wires 36 when they are energized, yet allows the proxim-

ity probe 14 to sense voltage.

[0022] The support bracket 18 is attached between the non-conductive body 16 and the inside of the enclosure 12 for mounting of the non-conductive body 16. The non-conductive body 16 mounts to the support bracket 18 using mounting screws 42 that screw into the material of the non-conductive body 16. The support bracket 18 can be welded to the enclosure 10 or attached using any other fastening means. The non-conductive body 16 and support bracket 18 are attached to the enclosure 12 such that the front face 22 of the non-conductive body 16 faces a slot shaped test hole 44 in the enclosure 12. The non-conductive body 16 is mounted such that the test hole 44 is aligned with the slot shaped open cavity 26 of the non-conductive body 16, so that the proximity voltage sensor 14 can be inserted into the slot shaped open cavity 26 from outside the enclosure 12. The test hole 44 is shown in a door 46 of the enclosure 12, but could be on any of the outside surfaces of the enclosure 12. It is in the slot shaped open cavity 26 of the non-conductive body 16 that the probe 14 is placed in close proximity to the wire terminals 34 which are shielded by the layer 40 in order to get a reading on voltage presence.

[0023] The electrical safety device 10 shown in Figs. 6-9 is an example of the second version. The second version differs in that it includes additional components to allow testing of voltage presence in the individual wires 36. The second version also illustrates mounting of the electrical safety device 10 to an outside surface of the enclosure 12. In this instance, the electrical safety device 10 is shown mounted to the door 46 of the enclosure 12. As in the first version, the electrical safety device 10 includes a non-conducting body 16 and wires 36 of a wire bundle. The non-conducting body 16 includes a outer shell 50 and inner core 52, which are both made of non-conducting material, such as nylon type 6. The non-conducting body 16 is shown as a round cylinder shape, but is not limited to that shape. The outer shell 50 has a front 54 and a rear 56. The outer shell 50 includes a deep open rear cavity 58 in the rear 56 of the outer shell 50 to receive the inner core 52. The outer shell 50 includes a ground shield plate 60 embedded in the front 54 of the outer shell 50. There is a shallow front cavity 62 in the front 54 of the outer shell 50. The front cavity 62 is sized just large enough to receive the ground shield plate 60 inside the front cavity 62. The ground shield plate 60 is

made of a electrical conducting material. The ground shield plate 60 includes a shield ground shaft 64 extending from the rear 66 of the ground shield plate 60 and into a ground shaft hole 68 in the center of the outer shell 50. The ground shaft hole 68 allows the shield ground shaft 64 to extend into the rear cavity 58 of the rear 56 of the outer shell 50. The ground shield plate 60 is shown with five probe holes 70. The outer shell 50 includes five round probe cavities 72 within the front cavity 62 of the outer shell 50. The ground shield plate 60 is placed into the front cavity 62 such that the probe holes 70 and probe cavities 72 are aligned for placement of the tip 28 of the proximity probe 14 into the probe cavities 72. The thickness of material of the outer shell 50 remaining between the probe cavities 72 and the rear cavity 58 is important. This thickness must be thin enough to allow the use of the proximity probe 14 with the components of the inner core 52, but thick enough to provide the required insulation value for the level of voltage being detected. A thickness of one-eighth of an inch has proved best for testing the presence of voltage.

[0024] The rear 56 of the outer shell includes a necked down threaded outside surface 74. There is a lip 76 formed be-

tween the necked down threaded outside surface 74 and the remaining portion of the outside of the outer shell 50. The necked down threaded outside surface 74 is used for mounting the outer shell 50 to the outer surface of the enclosure 12. In Fig. 6, the outer shell 50 is mounted to the door 46 of the enclosure 12. The door 46 includes an outer shell hole 78 sized large enough to allow the necked down threaded outside surface 74 to pass through the front of the door 46, but small enough to prevent the lip 76 from passing through the door 46. A lock nut 80 is threaded onto the necked down threaded outside surface 74 after the necked down threaded outside surface 74 has passed through the outer shell hole 78. The lock nut 80 retains the outer shell 50 on the door 46.

[0025] The inner core 56 is inserted into the rear cavity 58 of the outer shell 50. The inner core 56 is held in place either by a pressure fit or by an adhesive. The inner core 52 includes a inner core body 82 and button connectors 84. The inner core body 82 is a solid piece of non-conducting material with front 86, rear 88 and five connector cavities 90 in the front 86. The connector cavities 90 receive the button connectors 84. The inner core 52 is inserted into the outer shell 50 such that each button connector 84 is

aligned with the each of the probe cavities 72 and probe holes 70. The connector cavities 86 each include a wire hole 92 to allow the five wires 36 of the wire bundle to pass from the rear 88 of the inner core body 82 onto the button connectors 84. The button connectors 84 include a button shaped conducting surface 94 and a hollow sleeve 96 extending from the rear 98 of the contact surface 94. The conducting surface 94 and hollow sleeve 96 are of a electrical conducting material, such as brass and the hollow sleeve 96 is electrically connected to the conducting surface 94. Each of the five wires 36 is inserted into one of each of the five wires holes 92 and soldered into the hollow sleeve 96 of the button connector 84. The button connector 84 serves in the same capacity as the wire terminals 34 of the first version. The inner core 52 includes a inner core ground shaft 100 in the center of the inner core 52. The inner core ground shaft 100 is connected to a sixth wire 36 of the wire bundle that is a ground wire. The inner core ground shaft 100 is configured to connect and contact the shield ground shaft 64 when the inner core 52 is inserted into the outer shell 50. The inner core 52 also includes five ground spoke plates 102 at the front 86 of the inner core 52. The ground spoke plates 102 each ex-

tend from the inner core ground shaft 100 outward to the outside edge of the inner core 52. The ground spoke plates 102 should have a depth of at least the thickness of the button connector 84. It is also recommended to have a wire strain relief as part of the rear 88 of the inner core 52 where the wires 36 of the wire bundle first enter. As with the first version, no fusing of wires 36 is necessary. The reason for this is that the wires 36 are "dead-ended" at the buttons conductors 84. This is important because the device 10 costs less to manufacture and promotes a fail-safe device in that there are no fuses to "open" for whatever reason. It is believed that the button conductors 84 should be the same diameter as the probe holes 70 to promote voltage presence sensitivity within the hole 70.

[0026] The use of the two versions is as follows. To use electrical safety device 10 of the first version, first test the proximity probe 14 at a known voltage source. Next, turn off the power to the enclosure 12 and place the tip 28 of the proximity probe 14 into the slot shaped open cavity 26 near the first wire terminal 34. With the power off, there should be no indication of voltage by the proximity probe 14 at the first wire terminal 34. With the second and third wire terminals 34 being grounded, there should be no

bleed over from a voltage field produced by wires 36 three through five, if wires 36 three through five are still energized. It is possible that only one grounded wire terminal 34 would be enough to prevent voltage fields from bleeding over, but a second grounded wire terminal 34 provides an improved margin of safety. Next, place the tip 28 of the proximity probe 14 into the slot shaped open cavity 26 near the fourth through sixth wire terminals 34. With the power off, there should be no indication of voltage by the proximity probe 14 at the fourth through sixth wire terminals 34. Again, due to the grounded wire terminals 34, there should be no bleed over of voltage field from the first wire 36.

[0027] To use electrical safety device 10 of OLE_LINK1the second versionOLE_LINK1, place, first test the proximity probe 14 at a known voltage source. Next turn off the power to the enclosure 12 and place the tip 28 of the proximity probe 14 into the probe holes 70 and on into the probe cavities 72. With the power off, there should be no indication of voltage by the proximity probe 14 in each probe hole 70. The electrical safety device 10 of the second version provides grounded separation between each probe hole 70 and probe cavity 72 combination due to the ground shield

plate 60, shield ground shaft 64, ground spoke plates 102, inner core ground shaft 100 and the ground wire. This grounded separation prevents the voltage field from bleeding over from the other probe cavities 72 when placing the tip 28 of the proximity probe 14 into one of the probe cavities 72.

[0028] It should be noted that the electrical safety device 10 of the first version could be mounted directly to a wall of the enclosure 12 which has the test slot 44 or could be mounted to the outside of the enclosure 12. Also, the electrical safety device 10 of the second version could be mounted inside the enclosure 12 in a similar fashion as described in version one, whereby the test slot 44 could be replaced by a large round hole or several probe sized holes aligned with the probe holes 70.

[0029] Figs. 10-12 show a simpler version of electrical safety device 10 which can be mounted directly to the enclosure 12, inside the enclosure 12 or remotely located from the enclosure 12. The simpler version of Figs. 10-12 is the base model for all of the versions of the present invention, including the versions discussed above. Fig. 10 shows a non-conductive body 16 composed of a non-conductive material having a front face 104 and a rear mounting sec-

tion 106. The non-conductive body 16 of Fig. 10 can be mounted by inserting the rear mounting section 106 in a hole 108, as shown in Fig. 11. The rear mounting section 106 can be held in place by friction fit, locknut, gluing, threaded hole or other means to maintain the rear mounting section 106 in the hole 108. Fig. 11 shows the non-conducting body 16 attached to the enclosure 12 by inserting the rear mounting section 106 into the hole 108 of the enclosure 12. The non-conducting body 16 is shown retained by slightly flexible barbs 110 on the outside of the rear mounting section 106. The non-conductive body 16 can take on many different shapes. The front face 104 of the non-conductive body 16 can be concave, convex, flat, protruding, recessed or flush, as compared to the surface the non-conductive body 16 is mounted. A protruding flat face 104 is shown in Figs. 10-12. No cavity is required for the proximity probe 14. The proximity probe 14 need only be held at the front face 104. A wire 36 is shown as the conductor connected to a voltage source to be detected. The wire 36 can be an insulated conductor such as a common wire and can be held behind the front face of the non-conductive body by several methods. The wire 36 can be held in the rear mounting section 106 us-

ing non-conductive epoxy, non-conductive glue, a non-conductive plug, or by force fitting the wire into a hole in the rear of the rear mounting section 106. Fig. 12 shows front view of the front face 104 of four non-conductive bodies mounted to an enclosure 12. If the version of Fig. 10-12 is placed on a grounded enclosure 12 and spaced apart enough so that there is no need for a ground shield. The grounded enclosure 12 acts as the ground shield. The distance of the end of the wire 36 from the front surface of non-conductive body 16 is a function of the voltage level sought to indicate the presence of voltage. The wire 36 can be enlarged to increase the magnitude of the signal for the probe 14. Preferred method of manufacturing this simple version would be by injection molding.

[0030] Fig. 13 shows yet another version of the present invention which is similar to the version shown in Figs. 10-12. Fig. 13 shows as cut-a-way side view and front view of a non-conductive body 16 composed of any non-conductive material having a front face 104 and a rear mounting section 106. The differences are as follows. Within the rear mounting section 106 is a layer of electrical shielding 112 about the wire 36 and the rear of the rear mounting section 106. The wire 36 is also covered by a layer of electri-

cal shielding 114. The electrical shielding 112 of the rear mounting section 106 and electrical shielding 114 about the wire 36 can be connected together. The electrical shielding 114 about the wire can be connected to a ground by a tail wire 116 between the electrical shielding 114 about the wire 36 and the ground. This prevents other equipment in the enclosure from influencing the electrical safety device 10. Also, a terminal button 118 connected to the end of the wire 36 is shown in the non-conductive body 16. Finally, the front face 104 shows a dimple shaped cavity 120 in the middle of the face 104 to aid in positioning the probe 14 properly.

[0031] Each version discussed above can include any of component elements of any of the other versions discussed and the different versions are for illustrative purposes. The present invention allows an unskilled worker to safely verify the presence of voltage without the exposure to electrical hazards with removing covers, opening doors or destroying seals. It is envisioned that mixing of attributes of the above different versions will be performed to fit the particular needs of the user. Therefore, while different embodiments of the invention have been described in detail herein, it will be appreciated by those skilled in the art

that various modifications and alternatives to the embodiments could be developed in light of the overall teachings of the disclosure. Accordingly, the particular arrangements are illustrative only and are not limiting as to the scope of the invention that is to be given the full breadth of any and all equivalents thereof.